

IN THE CLAIMS:

[Please amend the pending claims as follows.]

1. (Currently Amended) An apparatus for occlusion testing primitives being processed in a graphics system, each primitive having a minimum Z value and a maximum Z value, the apparatus comprising:

logic configured to create a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level, said logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded, wherein if a determination is made that the tested primitive is not fully occluded, said logic determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if said logic determines that a subregion is fully covered by the tested primitive, then said logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive, wherein said logic to determines whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion, wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive

A multi-function unit of a graphics system, comprising:

a hierarchical tiler configured to occlusion test primitives, the primitives comprising a maximum Z value and a minimum Z value, the maximum and minimum Z values associated with respective X-Y coordinate values, the hierarchical tiler further configured to create a Z pyramid data structure as polygons defined by a plurality of primitives are processed by the multi-function unit;

a parameter interpolator coupled to the hierarchical tiler configured to receive the X-Y coordinate values from the hierarchical tiler and generate a Z value at the pixel level for each received X-Y coordinate value;

a pixel-level comparator coupled to the parameter interpolator configured to determine at a pixel level which values need to be written by a frame buffer controller; and

a memory unit coupled to the hierarchical tiler and the pixel-level comparator, the memory unit configured to store a change in a z-pyramid data structure responsive to an occlusion test result before the pixel-level comparator determines which pixel level values need to be written by the frame buffer controller.

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2. - 3. (Canceled)

4. (Currently Amended) The apparatus of claim 1, wherein said logic maintains a coverage mask for each level of the Z pyramid data structure, each coverage mask comprising a bit for each subregion of the level of the Z pyramid data structure associated with the coverage mask, wherein when said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, a bit in the coverage mask associated with the covered subregion is set. The multi-function unit of claim 1, wherein the z-pyramid data structure is periodically updated in accordance with pixel level values from a Z buffer responsive to the frame buffer controller.

5. (Currently Amended) The apparatus of claim 4, wherein when all of the coverage mask bits corresponding to the subregions of a particular region have been set in the coverage mask associated with the first level of the Z pyramid data structure, a bit is set for the corresponding region in the coverage mask associated with the second level up in the Z pyramid data structure. The multi-function unit of claim 1, wherein the pixel level comparison is performed responsive to pixel level values from a Z buffer responsive to the frame buffer controller.

6. (Currently Amended) The apparatus of claim 5, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, said logic replaces the maximum Z value for the particular region with the

maximum Z value of all of the subregions associated with the particular region The multi-function unit of claim 1, further comprising:

an object function unit coupled to the pixel level comparator and the Z buffer
configured to perform at least one function selected from clipping, patterning,
transferring, and filling.

7. (Currently Amended) The apparatus of claim 6, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, said logic sets the corresponding bit in the coverage mask for a next level up in the Z pyramid The multi-function unit of claim 1, wherein the hierarchical tiler maintains coverage masks to update the Z pyramid data structure.

8. (Currently Amended) The apparatus of claim 7, wherein the primitives are occlusion tested in a tiler component of the graphics system and wherein the Z pyramid data structure is updated by the tiler component on the fly as primitives are being processed through the graphics system The multi-function unit of claim 7, wherein the Z pyramid data structure comprises a plurality of levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion comprising a Z value.

9. (Currently Amended) The apparatus of claim 8, wherein the graphics system is comprised as part of a computer graphics display system, the tiler component being in communication with a Z pyramid memory element, the Z pyramid memory element storing the Z pyramid data structure The multi-function unit of claim 8, wherein the hierarchical tiler compares the minimum Z value of each primitive with the Z value of a region to determine if the primitive is occluded.

10. (Currently Amended) The apparatus of claim 9, wherein the Z pyramid memory element is periodically updated with pixel level Z values, the pixel level Z values corresponding to Z values of primitives which have been seen converted into screen coordinates corresponding to locations on the display monitor, and wherein the pixel level Z values are used by the tiler component to periodically reconstruct the Z pyramid data structure The multi-function unit of claim 9, wherein

when the primitive is not fully occluded, the hierarchical tiler determines whether any subregion of the region is fully covered by the primitive.

11-20 (Canceled)

21. (New) The multi-function unit of claim 10, wherein when a present subregion is covered, the hierarchical tiler determines whether the Z value of the covered subregion is to be replaced with the maximum Z value of the primitive.

22. (New) The multi-function unit of claim 11, wherein the hierarchical tiler maintains a coverage mask for each level of the Z pyramid data structure.

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23. (New) The multi-function unit of claim 14, wherein when the hierarchical tiler determines that the maximum Z value of the primitive is less than the Z value for covered subregion, a bit in the coverage mask associated with the covered subregion is set.

24. (New) The multi-function unit of claim 15, wherein when all the coverage mask bits corresponding to the subregions of a particular region have been set in the coverage mask associated with a first level of the Z pyramid structure, a bit is set for the corresponding region in the coverage mask associated with a next level up in the Z pyramid data structure.

25. (New) The multi-function unit of claim 16, wherein when all the bits in the coverage mask have been set for a particular region in the coverage mask, the hierarchical tiler replaces the maximum Z value for the particular region with the maximum Z value of all the subregions associated with the particular region.

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26. (New) The multi-function unit of claim 17, wherein when all the bits in the coverage mask have been set for a particular region in the coverage mask, the hierarchical tiler sets the corresponding bit in the coverage mask for a next level up in the Z pyramid data structure.